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"The most valuable gift which the Hand of Science has ever yet offered to the Artisan." *Dr. Birkbeck.*

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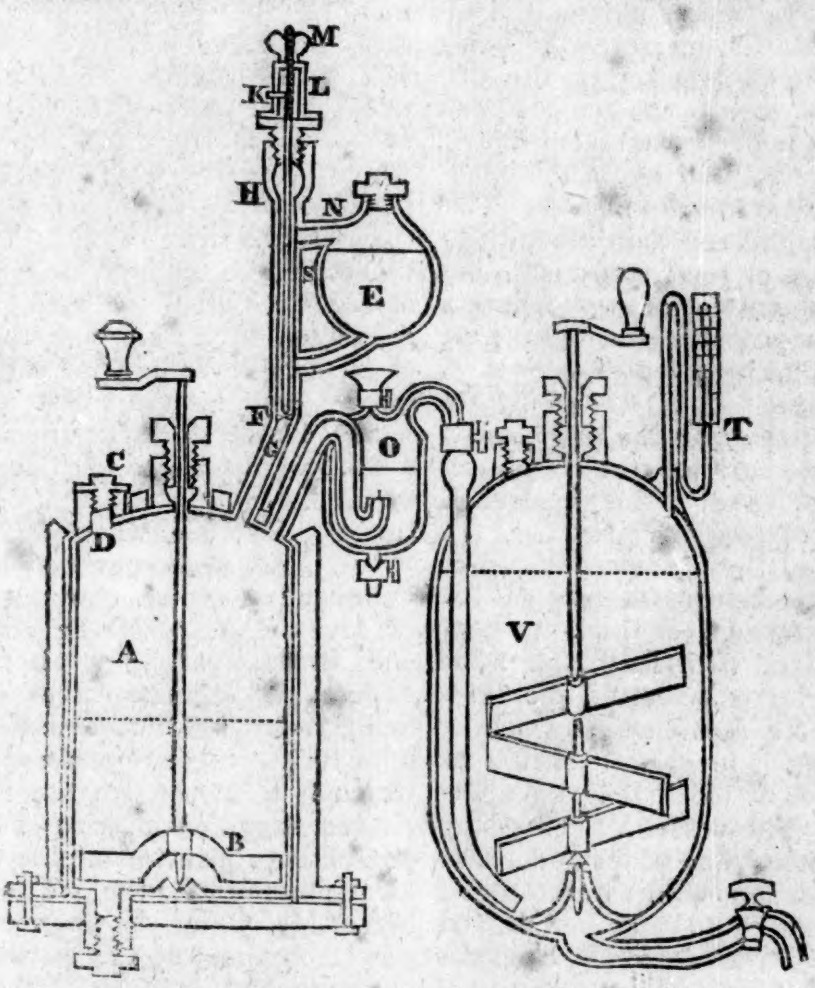
"Lord Bacon seems to limit Philosophy to the knowledge of things useful; recommending, above all, the study of Nature, and showing that no progress can be made therein but by collecting facts, and comparing experiments."—*Ferguson.*

CAMERON'S SODA WATER APPARATUS.



SIR,—In looking over some of the foregoing Numbers of your very useful Miscellany, I cannot help thinking it somewhat strange, that no answers are given to many of the useful inquiries; and knowing it to be your wish that your readers should answer them in preference to any other way, I have taken the liberty of sending the following description of an apparatus, invented by Mr. Charles Cameron, Chemist, Glasgow, for combining carbonic acid gas with water, in the large way, which, from the ingenuity displayed in its construction, deserves, I think, to be better known.

The vessel A, in the Fig. containing about fifteen gallons, is formed of cast iron, six-eights of an inch thick, and lined with sheet lead, of from eight to ten pounds per square foot, having an agitator, B, covered

with lead, working on the pivot below, and through the stuffing-box C. By the opening at D, the vessel is filled up to the dotted line with a mixture of whitening and water; the vessel E, containing two gallons, is formed of lead six-eighths of an inch thick, and is filled with sulphuric acid up to the dotted line; the acid is kept from falling down into A by the lead plug F, which is conically pointed, and fits into a corresponding conical opening in the lead pipe G; the plug moves straight up and down through the stuffing-box H, and is prevented from turning round by the pin K, which moves in a slit in the bridle L, the screw M being riveted loose into the top of the bridle; by this means the conical point of the plug is preserved from injury, as it is merely lifted out of the opening, and again pushed into it. This is more complicated than a common-formed glass or lead stop-cock, but neither of them will answer where a high pressure is applied. The pipe N, inserted into the top of the vessel E, and into the pipe S (*which encloses the plug*,) preserves the equilibrium of pressure; so that the sulphuric acid rises no higher in the pipe S than in E, and consequently preserves the brass work of the stuffing-box. The intermediate vessel *o*, containing three gallons, is formed of thick lead, or cast iron lined with lead, and filled with water up to the dotted line. It is employed for retaining any of the sulphuric acid, in case it should be carried over by too strong an effervescence. The vessel V, containing sixteen gallons, may be formed either of copper tinned, with an agitator of the same metal, or of cast iron lined with lead, of from six to eight pounds per square foot, and an agitator of maplewood, which gives no taste to the water. It is filled to the dotted line with water, and a proportional quantity of carbonate of soda, magnesia, or other substance, to be impregnated. T is a pressure-guage, containing mercury; in the Fig. it is placed on the top of the vessel, but it is more convenient to place it at a little distance, forming a communication by a pipe. The communicating pipes are lead, and their several uses are distinctly evident in the figure. When the vessels are filled, the mode of operation is extremely simple. On turning the nut M, the sulphuric acid is allowed to come in contact with the whitening; carbonic acid is necessarily disengaged, and in quantity and rapidity proportional to the quantity of sulphuric acid let down.

If the vessels were sufficiently capacious, 10,000 gallons of carbonic acid would be instantaneously produced; but by the alternate turning of the nut M, the sulphuric acid is allowed to fall down in small portions, which regulates the disengagement of the gas, and prevents too great an effervescence, as the gas is still accumulating. Having no way to escape it passes over into the vessel V, and is there absorbed by the water. In this way, a pressure of from 20 to 30 atmospheres may be thrown into the vessels, It must, therefore, be obvious to every man of science, that if the vessel A were connected by a pipe with the valves of an engine somewhat similar to a steam engine, the vast pressure which can be so instantaneously produced, would raise and depress alternately the piston of a cylinder; that cylinder, too, would only require to be 1-20th the diameter of the steam cylinder to have an equivalent power, and the gas would be reduced to one atmosphere by its alternate escape at the opposite valves, no water being required for condensation; but, unfortunately, the expense of sulphuric acid, from the quantity required, (*when the gas is allowed to escape*,) presents an insurmountable obstacle as a substitute for the steam engine. Since Mr. Cameron discovered the power obtained by the production of carbonic acid, and put it into practice four years ago—a fact which was noticed in most of the journals and newspapers of the day—Sir H. Davy has turned his attention to the subject, and discovered that gases, at a high pressure, are powerfully acted upon by slight increments of temperature, and that the pressure is astonishingly augmented.

This circumstance affords ground to hope that an engine, constructed on the principles of the Rev. Mr.

Sterling's air engine, may yet be made to equal, and, in many cases, to supersede the steam engine.

The foregoing is the substance of a letter written to Dr. Brewster by the inventor, and published in the Edinburgh Philosophical Journal.

I am, Sir, &c

JAMES MARSH.

Woolwich, Aug. 14.

IMPREGNATING FIXED OILS WITH ESSENTIAL AROMATIC OILS.

SIR,—The subjoined passage, respecting the art of impregnating fixed Oil with the essential Oils contained in aromatic Seeds and Barks, I have extracted from a small work on the Medical Topography of the Interior of Ceylon, by Mr Marshall. Pray give it a place in your widely-circulated publication; some of the chemical readers of which will, perhaps, be kind enough to state, through the same channel whether they consider Mr. Marshall's conjecture regarding the mode of compounding an "oil of holy ointment," as directed by Moses, Exodus xxx. 22, 24, possesses a feasible foundation.

F. P. C.

"The Kandyans, as well as the natives of the Peninsula, of India, are acquainted with the art of preparing compound and odoriferous oils, by impregnating fixed oils with the essential oil which is contained in aromatic seeds and barks. Oils of this kind are occasionally externally applied by the Kandyan Vederales. The process is as follows:—After the aromatic substances are coarsely powdered, they are put into an earthen vessel; the fixed oil is then added, and afterwards water, sufficient to cover the dry substances introduced; the vessel is put upon a fire, and the water made to boil; the boiling is continued until great part of the water is exhaled. During this process, the essential oil of the aromatics unites with the fixed oil, and impregnates it with the peculiar fragrance of the odoriferous seeds or barks used. Perhaps a knowledge of this fact may contribute to obviate the difficulty brought forward by the compilers of the French Encyclopedia, in regard to the cinnamon mentioned in Scripture. They aver, that the kinnamon of the Hebrews, mentioned in Exodus, chap. xxx. is not that of the Greeks and Romans, the modern cinnamon. Moses was ordered (see verses 22, 23, and 24) to take cinnamon, and other aromatic substances, of which he was to make "an oil of holy ointment," for the purpose of anointing the tabernacle, &c. The Encyclopedists profess to think, that the substance here designated by the term "kinnamon," must have been a gum, or an oil, rather than an odoriferous bark. Immediately after the enumeration of the aromatic substances, Moses is directed therewith to prepare "an oil of holy ointment," an ointment compound, after "the art of the apothecary, a holy anointing oil." The process for preparing the oil, or ointment, is not farther stated. There is much probability that the holy oil was prepared in a manner approximating to the process above detailed.

"The following are the articles directed to be used by Moses in compounding the holy oil, or ointment:—

	Shekels.	Lbs. Troy
Myrrh	500, or about	18
Sweet cinnamon .	250	9
Calamus (acorus calamus,) Indian sweet rush	250	9
Cassia	500	18
Olive oil, a hin	. . . .	10

"Water alone is wanted to complete the requisite substances needful for the above process.

"Should the process adopted by Moses for preparing perfumed oils have been similar to the one practised by the Indian doctors, some conjecture may be formed in regard to the nature of the composition designated in Scripture "an holy ointment," and a "holy anointing oil." It would appear, by the 23d and 24th verses, that cinnamon entered largely into the composition of the "holy anointing oil." This substance must, therefore, have been extremely precious. In ancient times, the trade in cinnamon was very circuitous; a circumstance which rendered the spice of great value in India."

FOUL APARTMENTS.

Hold your head as high as you can, when obliged to go into a place where the air is foul; foul air always sinking to the bottom of an apartment. Do not sit or lie down as you value your life.

BOOKS ON TURNING.

SIR,—Will you permit me, through the medium of your excellent work, to thank G. A. S. for having given me the first intimation of there being such a work on Eccentric Turning as Mr. Ibbetson's. I have just procured the volume from London, and think it a valuable book of instructions for beginners in eccentric turning. I

hope we shall soon receive the information which your Correspondent G. A. S. has offered you, with the drawings of the chucks and tools which are used in the art of turning. There is another book which, perhaps, is not generally known, and which was published about a year after Mr. Ibbetson's, by Mr. Ritch, entitled "Specimens of the Art of Ornamental Turning, in Eccentric and Concentric Patterns;" sold by Skelton and Co. Southampton, and Whittaker, London. It contains six large plates, engraved by Lowry, of vases, temples, and pagodas, making handsome ornaments for chimney-pieces.

INQUIRY.—I shall be exceedingly obliged to any of your Correspondents, if they will inform me of the best method of staining or dying ivory red and black, such as chess-men, billiard-balls, &c. I have tried the receipts given in books, but the colours produced by them are not so beautiful as those produced by the manufacturers of brilliant balls.

I am, Sir, &c.

AN AMATEUR MECHANIC.

Falmouth.

ON THE STRENGTH OF LEATHER.

SIR,—In most of our elementary treatises on mechanics will be found tables of the strength of various substances, such as the different metals and various species of wood, and also of ropes and cords: but I am not aware of any good experiments on the Strength of Leather published in any of our books of general circulation; and as leather is an article of very extensive use, both in harness and in machinery, I consider it an object of some importance to be a little acquainted with its strength; for the benefit or amusement of your readers, I beg leave to send the result of some experiments on that subject.

I took a piece of good leather, manufactured from a cow's hide, such as is usually made into harness; length 13.30 inches, width 1.32, thickness 0.14, and weighing 1.2 ounces avoirdupois. In order to ascertain the proportion of extension to the weight applied, I had two marks made on the strap, at six inches distance.

The extension of six inches by

120lb.	was	0.7
170	—	0.9
220	—	1.0
270	—	1.1
320	—	1.24
370	—	1.44
420	—	1.55
470	—	1.65
520	—	1.70
600	—	2.00
680	—	broke.

The fracture was not at the centre of the strap, where the contraction was the greatest, but at one end, occasioned by a slight cut of the vice by which the strap was held.

The ratio of extension by half the breaking weight, expressing the length by unit, was 0.22, or nearly one inch for every 4½ inches in length; the force of cohesion per square inch being 3981 lbs. and the modulus of cohesion equal to 10049 feet.

In a similar manner I tried other species of leather, and obtained the following results:

	Cohesion, lbs. per sq. inch.	Modulus of cohesion in feet.	Ratio of extension, by ½ breaking wt.
Calf skin	1890	5050	0.165
Sheep skin (basil) . . .	1610	5600	0.191
Horse skin (white) . . .	4000	11000	0.187
Horse skin (kip)	3200	7000	
Horse skin (cordovan) . .	1680	3720	
Cowskin, as above . . .	3981	10049	0.22

To find the weight necessary to break or tear asunder any strap of leather, it is only necessary to ascertain the weight of one foot in length in lbs. and decimals, and multiply the modulus in feet by the weight so found; the product will be the greatest load the strap will bear, even when the leather is new, but not more than $\frac{1}{3}$ or $\frac{1}{4}$ of the weight thus found should be trusted for any considerable time. B. BEVAN.

CENTRE OF GYRATION.

SIR,—Dr. Olinthus Gregory, in his excellent Treatise on Practical Mechanics, art. 312, has inadvertently given an incorrect theorem for finding the *centre of gyration* of a cylindrical ring, and unfortunately, this error has been copied into Morrat's very useful Introduction to Mechanics, page 381; and as the most essential part of a fly-wheel consists of such a ring, some of your practical readers may be a little puzzled by this error in books of such general utility. This notice, I trust, will be accepted, as it is intended to prevent practical errors, and not to depreciate the value of the above-mentioned publications.

Let R denote the distance from the centre of the fly-wheel to the outside of the rim, and r the distance from the centre to the inside of the same, then $\sqrt{\dfrac{R^4-r^4}{2R^2-2r^2}}$ distance of the centre of gyration of the rim.

B. BEVAN.

REFLECTING LIGHT-HOUSES.

The use of mirrors for reflecting light-houses in England is of very recent date; and although the idea was not suggested by the falling of an apple, nor the dissection of a frog, it owes its origin to a circumstance almost as trivial, which was as follows: At a meeting of a Society of Mathematicians at Liverpool, one of the members proposed to lay a wager that he would read a paragraph of a newspaper at ten yards distance with the light of a farthing candle. The wager was laid, and the proposer covered the inside of a wooden dish with pieces of looking-glass, fastened in with glazier's putty, placed this reflector behind his candle, and won the wager. One of the company viewed this experiment with a philosophic eye. This was Captain Hutchison, the dock-master. With him originated those reflecting light-houses at Liverpool, which were in the year 1763. In his Treatise on Practical Seamanship, he says, "We have made and had in use here at Liverpool, reflectors of 1, 2, and 3 feet focus, and 3, 5½, 7½, 12 feet diameter, the three small ones made of tin soldered together, and the largest of wood covered with looking-glass; the two large ones, called the sea-lights, leading through the channel from the sea, till the two Hoydule lights are brought in a line that leads into a very good roadstead to lie, till it is a proper time to proceed to Liverpool."

Glasgow Mechanics' Magazine.

[Antecedent to the year 1812, Capt. Winslow Lewis of Boston, obtained a patent for an improvement in reflectors for Light Houses. The Government purchased the right, and since that period, they have been generally introduced into use in the United States. The improvement consists in conforming the reflectors to the parabolic curve, and furnishing them with glass chimnies. They have proved far more beneficial to mariners, than the lights formerly used, while the expense for lighting has been considerably diminished; but there is room still left for the exercise of economy, both in respect to the manner of lighting, and in the structure of our Light Houses. The former ought unquestionably to be effected with gas, because the lights would be more clear, and the expense would be very trifling, particularly, if tar were to be used for its manufacture; while cast-iron supporters for the lantern it is believed, might be elevated to a considerably greater height, than our Light Houses are at present, and at a less expense; besides there would be less difficulty in securing foundations, so that they might be used on the morasses of the Mississippi or elsewhere.—*Ed.*]

PRACTICAL GEOMETRY; BY T. S. DAVIES.

[A knowledge of Geometry is so essential to the greater part of our practical mechanics, that it would seem surprising so little has been done towards rendering that science a *popular* study. It becomes not a writer upon the same subject to censure his predecessors for the inadequacy of their works to effect such a desirable emulation amongst the artisans of our country—amongst that class of men upon whom the prosperity of this country mainly depends; nor, indeed, do I think that preceding writers deserve censure, for their object has not been so much to facilitate the acquisition of a Course of Problems which may be required in the practice of any particular trades, as to create a spirit of philosophical inquiry, and make a race of speculative geometers. However, so far as my limited acquaintance with the operative employments which require the aid of geometrical knowledge qualifies me for the task, I shall gladly so far contribute to my country's welfare in the publication of a course of problems for the use of that class of my countrymen. I had, indeed, some time ago, projected a course which should commence with the first principles of the science and the rudiments of lineal drawing, and collected a large stock of materials for the purposes of illustration; but, finding that a gentleman who signs G. A. S. has determined upon a similar undertaking, and feeling assured of his extensive learning as a geometer, and his intimate knowledge of the practice and applications of the science, I feel happy to give up the task into hands every way fitted for its most complete performance. My determination not to trespass upon the manorial rights of Mr. S., however, does not forbid me entering upon the geometry of solid bodies, their intersections, &c. This branch has scarcely been noticed by any man of science in this country, except Mr. Nicholson, with any practical intentions; I shall therefore, endeavour to place it in so familiar a point of view as to be apprehended by those whose minds have not been very long initiated to such pursuits. Such is my aim; how far I succeed is not for me to even guess: all I can say is, that I have intended well, and done my best.]

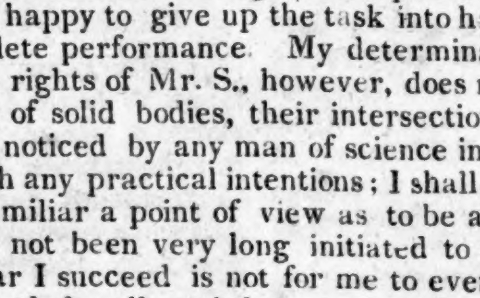
No. I.

THE SPHERE AND CYLINDER.

PROB. I.—To transfer any given circle from the surface of a sphere, cone, or cylinder, to any flat surface.

Take any three points, A, B, C, in the given circle; and with the distances A B B C, C A, construct the triangle A B C; then the circle described about this triangle is equal to the given circle upon the cone, sphere, or cylinder. (Fig. I.)

Fig. 1.



Note 1.—It will be practically most convenient to take A B equal to B C.

Note 2.—I have only inserted a figure for the sphere, the other cases being so similar as to require no additional diagram.

PROB. II.—To find the pole of a *given* great circle of the sphere.

DEF. 1.—It may be necessary here to remark, that the *pole* of a circle on the sphere is that point in which the compasses are set to describe such circle.

DEF. 2.—A *great circle* is the *largest* circle that can be described upon the sphere, and always divides the sphere into two *equal* parts.

DEF. 3—The less circles of the sphere are any which can be drawn to lie wholly *on one* side of a great circle, or which, when transferred to a flat surface, have a less diameter than the great circle. Such are the parallels of latitude on a terrestrial globe.

DEF. 4.—By the *plane radius* of a circle, we mean the radius of the transferred circle; and by *plane circle* we mean the transferred circle.

DEF. 5.—By the *describing radius* we mean that opening of the compasses which is required to describe any circle on the sphere. It is always greater than the PLANE radius.

Having premised these definitions, we now proceed to the construction of the problem.

Let D E (Fig. 2) be the plane great circle: divide the semicircle equally in F, then the opening F D is the describing radius. Fix one point of the compasses in any point, D, in the given great circle on the sphere, Fig. 3, and describe an arc (or, as it is more frequently called by workmen, an *arch*;) remove now the foot of the compasses to another point, K, in the given great circle, and describe another arc, cutting the former in F. This point F is the pole required.

Fig. 2.

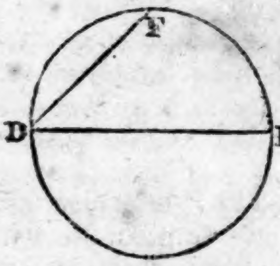
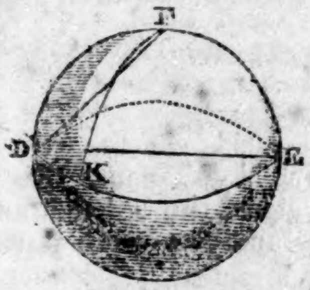
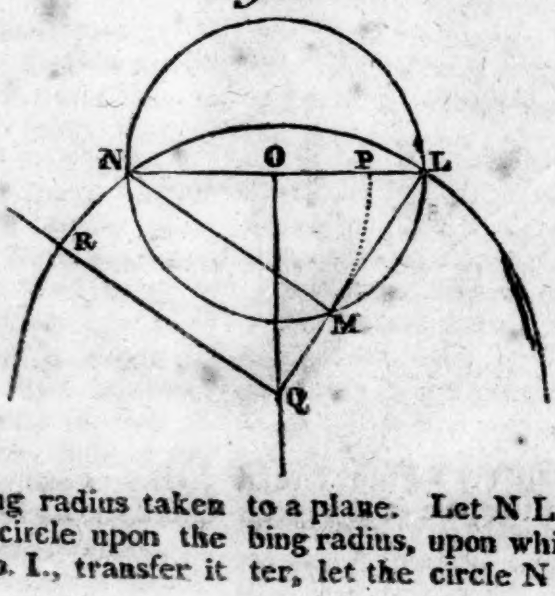


Fig. 3



PROB. III.—To find the great circle of any given sphere, and thence to describe that circle from any given point as a pole. (Fig. 4)

Fig. 4.



With any describing radius taken at pleasure, draw a circle upon the sphere, and, by Prob. I., transfer it to a plane. Let N L be the describing radius, upon which, as a diameter, let the circle N M L be drawn.

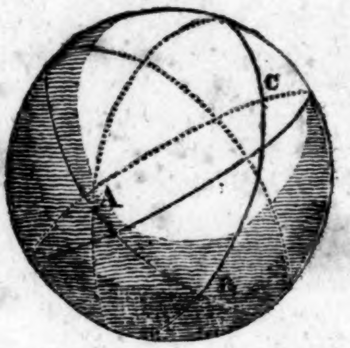
With the plane radius of the same circle on the sphere, N P, describe the arc P M cutting the semicircle in M. From O, the centre of N L, draw the perpendicular O Q, and prolong L M to meet it in Q. Then Q L is the plane radius of the required great circle. Draw Q R parallel to M; N will cut the plane circle in R, so that R L is its describing radius.

Note.—The mode given of performing the last operation is noticed here, principally to recommend the use of the parallel ruler to every one who has the least occasion for lineal drawing: it is cheap, portable, and of more general use than any instrument whatever, except the compasses and sector.

PROB. IV.—To draw a great circle that shall pass through two given points on the sphere.

Let A B be the two given points. Find (Fig. 5) a great circle of the sphere (by Prob. III.,) and with its describing radius, and the two given points as poles, describe arcs to cut each other in C. This point C is the pole of the great circle which passes through the given points.

Fig. 5.

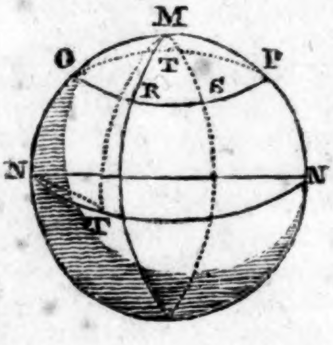


PROB. V.—To find the pole of a less circle of the sphere, and thence to draw another circle parallel to it. (Fig. 6.)

Find the plane radius of the given circle, and set it off successively from any point O in that circle, the distances O R, R S, S P, P T: through R T and O P describe great circles. Their intersection, M, is the pole required; from which any other circle, N N, being described, will be parallel to the given circle O P.

PROB. VI.—To draw a circle at any given distance from a given circle, and parallel to it. (Fig. 6.)

Fig. 6.



Draw (by Prob. V,) a great circle, N M N, through the pole of the given circle. From the sectoral scale of chords take the chord of the sum or

difference of the given distance between the two circles, according as the circle is to be drawn greater or less than the given circle. With this describing radius and the pole M, the required circle is to be drawn.

Note.—I have here taken for granted the knowledge of the principal uses of the sector; not that I suppose every workman, even though the most intelligent, acquainted with the instrument, but because it could not be conveniently introduced into the body of a paper like this.

PROB. VII.—To draw a great circle upon the sphere, making a given angle with a given circle. (Fig. 6.)

If the point of intersection be not given, assume one, as M. Draw from M, as pole, a great circle, N L N. From the sectoral chords take N. L. equal to the chord of the given angle. Through M L describe the great circle M L, and it is that which was required.

Note.—By this rule the *meridians* are traced upon a globe, and by the preceding problem the parallels of latitude are drawn.

I cannot pass over this problem without urging upon all who are engaged in tuition, the importance of making their pupils not only project maps, but also actually trace the principal lines upon a globe. The impression thus made would be much stronger than could possibly be made by mere plain maps. For the purpose of practice, they may use a ball of about five or six inches diameter, *painted white*, upon which to trace all the lines with black lead pencil: this may be washed off with soap and warm water, whenever it may be required. The same method, too, should be adopted in the study of spherical geometry; and I am confident—and my confidence is founded on long experience—that a boy would learn more geometry in a single month, by a process of this kind, than he could in twelve, by merely studying the projected lines. Indeed, had not our own eyes seen, our own ears heard it, we could not have believed that models are denied to the pupils in the *first places of education in this country*; and that while the reasoning faculties are all upon the stretch to discover the nature of an argument, the imagination is tortured to believe that a flat figure is a solid body, and that two unequal lines upon paper must be equal in the represented solid!

I should recommend my readers to procure such a ball as I mention, and also a cylinder, for the following problems. In short, whatever you reason concerning, whatever you study, always have the object actually before you; so that you can turn it in what direction you please, and feel certain of the equality or inequality of those parts you are considering.

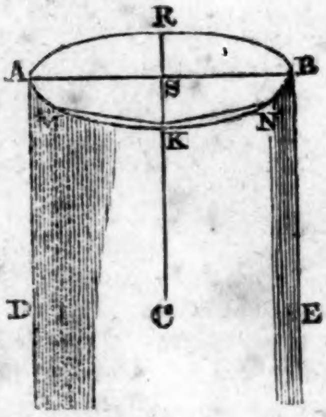
Were it not for fear of being tedious, I should even propose to allow pupils, instead of "doing maps," as a geographical exercise, to employ them to *construct globes*: but as the method of tracing the paper gores, so as to fit upon the sphere, could not be here introduced, I shall pass it over for the present. The thought is novel—by some it may be deemed wild; but the day will yet come when there will be no respectable school-establishment in which it shall not be introduced. These globes may be mounted at a small expense, and would be a source of pleasing remembrance to many a pupil long after he has entered upon the busy cares and anxieties of active life.

PROB. VIII.—To draw through a given point on the surface of a cylinder a line parallel to the axis, or, which is the same thing, in the direction of the length of the cylinder. (Fig. 7.)

Let A B E D be a perspective representation of the cylinder, and C the given point. With any convenient opening of the compasses, greater than C K, describe a circle cutting the circular end of the cylinder in M and N. Bisect the arc M N in K; then K C is the direction of the line whose position was required.

Note.—In this proposition it was supposed that the cylinder was "*squared*" at the end. Where this operation cannot be performed, it

Fig. 7.



will be requisite to find the position of the longest axis of an eclipse : but as such a case, I should think, could rarely occur, I have reserved the method of effecting it for that part of this series of problems which relates to the cone and its sections.

PROB. IX.—To trace a line, K L, upon a given cylinder *opposite* to a given line C K. (Figs. 7 and 8.)

Through the centre, *s*, of the circular end draw K R ; and imagine the back of the cylinder, in fig. 7, turned towards you, as in Fig. 8. Take then any two points, *n m*, equidistant from R ; from those points, as centres, with any convenient radius (the same in both instances,) describe arcs cutting each other in L. R L is the position of the line required.

PROB. X.—From any point, C, on

Fig. 8.

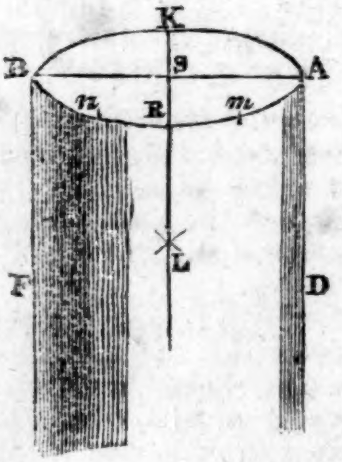
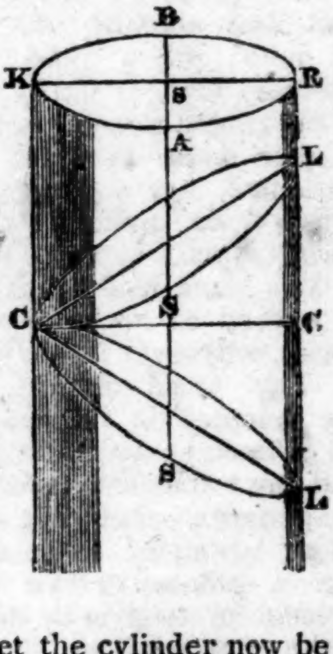


Fig. 9.



the surface of the cylinder, to find the position of the plane of section which shall make a given angle with the axis.

Let the cylinder now be so turned that K C, R L, shall occupy the positions denoted in Fig 9. Find C K, K R, R L, as in the last problem ;

C L′ (as the case may require,) equal to the sectoral tangent of that angle which would make the given angle equal to a quadrant.

If now B A be perpendicular to K R and passing through s, and A S be drawn parallel to the axis (Pr. 8) in which A S, or A *s*, (as the case may require,) is taken equal to half the sum of K C and R L (or of K C and R L′, when the case requires it,) we get S or *s*, the third point, which, with L and C, determine the plane of section required.

Note 1.—When the angle which the plane makes with the axis is half a right angle, the line C L, or C L′, is equal to C C ; a remark which will be used in the next paper, on the *cycloid*

Note 2.—The chalk string held at C L, or C L′, will mark the curve C s L, or C S L′, upon the cylinder.

Having thus performed the principal problems which can occur in the practical geometry of the sphere and cylinder, and that without the aid of any inaccessible points or lines, I shall close the present paper by remarking, that in my future communications I shall aim at the simplicity, perspicuity, and illustration, which ought ever to be the object of him who writes for the purposes of instruction.

Bath, October 6.

CLOCK-MAKING.

SIR,—The following communication is copied from the "Gentleman's Magazine" of the year 1757 ; should you think it likely to forward the views of ingenious Clock-makers, you will oblige me by giving it a place in the Mechanics' Magazine.

I am Sir, &c. S. D.

Skinner-street, Snow-hill.

"A Clock, of a new construction, invented and presented to the Royal Academy of Sciences at Paris, by M. le Roy the Younger, Member of the Royal Academy of Angers. It consists of two wheels only, one for the movement, and the other for the striking, besides the rocket, which forms the scaping, and the detent and lifter of the hammer ; this is all that is contained in the frame. The rocket is alternately moved upwards by the action of the wheel which carries the weight, and downwards by its own weight. When the action of this wheel ceases, which it does every half minute, the pendulum acts at freedom for thirty seconds together, and the lost motion is restored at the one-and-thirtieth second, by one of the pins fixed on the moving wheel, which then bears on an inclined plane fixed to the verge of the pendulum. This pendulum, by means of another piece fixed to its verge, serves likewise to regulate the striking part. This clock appears to be equally simple and ingenious, and sufficient to do honour to the talents and capacity of its author."

ANOTHER EXTRACT FROM THE SAME WORK.

An Equation Clock, proposed by M. Berthored, clock maker, at Paris. By an extremely simple mechanism, the striking part moves on the annual wheel one tooth a day, and two on the 28th of February, when it is not a Leap-Year. The equation is shown by an absolutely new method. This construction has been thought very ingenious, and more simple than any hitherto proposed for the same effects.

PROBLEM FOR MILLWRIGHTS.

SIR,—Some of your Correspondents have amused us lately with the revolutions and calculations of Cog Wheels the reading of which has induced me to send you the following Question, in hopes that some one or other of your readers will give me an answer to it :—

There are to be four spur wheels ; one of them is to have 99 cogs, and the other three to have 100 cogs each ; they are all to work at the same time and into each other; and I want to know how they must be placed, so that two of them shall make 100 revolutions each, in the same time that a third wheel makes but one revolution : the solver may do what he chooses with the fourth wheel, only keep it amongst the rest. The thing can be done, and, when properly constructed, will form a very powerful and useful machine.

I am, Sir, &c.

J. R. (not J. K.) A MAN IN THE MOORS.

MR. NEWTON'S LECTURES ON ASTRONOMY.

SIR,—Reading in a morning paper an account of a Lecture delivered by Mr. Newton at the London Mechanics' Institution, on Astronomy, I perceive he took occasion in the course of his address, to illustrate his remarks by comparing the sun's magnitude to the dome of St. Paul's, and reducing the sizes and distances of the planets to the relative proportions. I think he should have had the candour to have alluded to the work whence he borrowed his idea.* The statement was, perhaps, sufficiently correct for his purpose; but the calculation was erroneous in one main point, viz. supposing the earth to be ten inches in diameter, the dome would be very nearly twice the circumference of the sun.

I am, Sir, &c. R. W.

Oct. 13th, 1824.

The work or Table referred to, shows, in a very perspicuous manner, the relative magnitude of the sun, the moon, and the planets; also the relative distances of the planets from the sun, and the moon from the earth, together with their orbits and periods of revolution; assuming the magnitude of the earth to be that of a globe twelve inches in diameter. It appears by this Table, that, supposing the earth to be the size of a 12-inch globe, its distance from the sun would be 2 mil. 2 fur. 42 yds. 2 ft.: according to this calculation, the sun would be something larger than half the size of the dome of St. Paul's, taken as the half of a sphere, and the earth in its orbit would move over Stepney-green, Bethnal-green, Kingsland-crescent, Canonbury-house, Pancras Workhouse, the Regent's Circus, Grosvenor-square, Constitution-hill, Vauxhall-bridge, Kennington Common, Walworth Chapel, Kent-road, north of Sussex-place; Paradise Row, Botherhithe; Coal Stairs, Shadwell; and thence to Stepney-green; which journey would be performed in 1 ho. 6 min. 29 sec. The moon would revolve round the earth during this period of its revolution, so as to be in conjunction with the sun, rather more than 12 times, at a distance of 30 ft. 5 in.

ON HEAT AND STEAM.

SIR,—I beg to hazard a few opinions on Steam, and the probability of preventing Explosion of Boilers; but holding anti-Newtonian opinions respecting attraction and heat, I shall confine myself to common-place language as much as possible, and, to avoid prolixity, by frequent elucidations, make a few preliminary remarks.

First.—Attraction, as I conceive, has no existence in nature: there is no proof of its being the cause of a single phenomenon. All phenomena consists in change of place of particles or bodies; and cohesion, as well as dissolution, is but the effects of pressure, according as this takes place on the outside of a body or within it.

Secondly.—I hold that there is no such thing as a hot body: the particles of matter, being unchangeable and inert, are always in the same state, and perfectly incapable of acting on each other, or of suffering change, except as relates to situation. Heat is the state of feeling; to provoke which it is not requisite that matter should be hot, any more than that matter should be coloured or noisy, in order that colour or sound should be perceived. Heat is a mental effect only, as much as colour or sound.

Thirdly.—Fire does not communicate any thing to bodies; on the contrary, it causes them to suffer loss. Thus linen cloth, paper, coal, and wood, are deprived of some of their elementary particles by fire, and the loss is sensible. In like manner, when indecomposable substances are in contact with fire, they lose only electric matter; for fire can act but uniformly. The cause of expansion, which fire is necessary to the production of, it is unimportant to mention here; besides, the proof requires a much extended series of illustrations.

Fourthly.—Fire is as inactive as any other species of matter. The elements it consists of are common to all manner of bodies, and from its increase by the addition of what is not fire, it is obvious that it consists of common matter in a state of mixture, so as to favour the dissolution or decomposition of whatever is in contact with it, by serving as a minus pressure. Fire effects reduction of a body, by reason of the medium which attends it being such that the interstices between the particles serve as so many vacuums or recipients for whatever may be pushed into them, and the effects of the general compression which all things are under are the cause of transfer or change of place of the particles of bodies in the direction of fire.

From these premises there appears no office for attraction to perform, to pass over all the disservice it would be productive of.

Water suffers loss by fire of electric matter, which is visible on the bottom of a bright vessel in the form of air bubbles. These bubbles ascend only as the water cools, and then do not escape: were they air, or any thing communicated by fire, after penetrating a plate of metal, they could not be resisted by the water so as to be kept beneath it. *Fire takes*, and this is the matter it takes from water; and expansion follows when steam is thrown off.

* The work alluded to is "The Solar System," arranged in a new and familiar manner, by R. W. published by John Souter, about ten weeks ago.

The question then is, *could not water be de-electrized without fire, so as to promote its expansion?* The thing is actually done by nature in all cases of congelation, wherein the expansive effects are far superior to any produced by steam. In the next place, steam is not water; it is less than water, by what fire takes from water in order to produce it; and, as the expansive power of steam is lessened or increased, according as the medium it enters is colder or hotter than boiling water, by which it acquires, in the first instance, what fire took, and becomes more deficient of the same in the second, might not steam be still farther de-electrized, by means of *the machine and conductors,* so as to put it in a state of much greater expansion than what it is dependent on fire for? The mode to increase the power of steam is, manifestly, by following up the means which produced it, namely, by de-electrization; and could the same be effected on cold water or on steam, the expense of fuel, it is presumable, would be considerably reduced; but, with cold water, the *power* would be immense, and the boiler (calling the water vessel by that name) could never wear out; explosion, too, could never result from decay of material.

Under the present system of working steam engines by fire, I would propose, whether a species of self-regulation might not be introduced, so as to conduct electric matter to and from the water in the boiler, or to and from the steam in the dome of the boiler, so as to maintain the power always equable, and thereby get rid of safety valves, on which alone it is erroneously considered prevention from explosion depends?

I would next suggest, whether beneficial effects might not be obtained by conducting from the boiler the stratum of electric matter which accumulates on the bottom beneath the water? The formation of steam depending on the abstraction, by fire, of electric matter from water, it may be inferred that the more speedy removal of such would promote the generating of steam faster than by fire alone, and thereby lessen the consumption of coal. This increase of quantity of steam would render hazardous high pressure unnecessary. The stratum of electric matter, by keeping the water from touching the bottom of the boiler, may be productive of the great decay the metal is subject to. It may also promote the formation of the solid matter in the boiler, which, with the metal botom, is an additional hindrance to its escape towards the fire.

In conclusion, it is to be remembered that, according as electric matter is to be conducted to or from the boiling water, and sought after by self-acting means, the medium into which the conductor externally is placed, should be cold or hot. Cold water imparts, hot water abstracts, electric matter. Towards perfecting the foregoing speculations, I would recommend, that instead of being deluded by what are called attractions and chemical properties of matter, none of which, in my opinion, matter possesses, all change should be looked upon as to be effected by the *opposite.* of what is to be changed—heat by cold, and electricity by its opposite.

T. H. PASLEY.

Chatham Dock Yard.

DOUBTS *versus* DIFFICULTIES.

SIR,—I do not admit the principle which J. Y. assumes that water increases friction and oil diminishes it, I contend that they both diminish friction. In large machines water is frequently used to lubricate the axles of wheels, as being less expensive than oil, and I have always understood it answered the purpose extremely well. Neither can I admit that an edge-tool is *set* quicker upon a Turkey stone with oil than with water; but in either case the abrasion must evidently be produced by a mechanical and not by a chemical action. The difficulty in using water with a Turkey stone is, that it cannot be kept upon the face of the stone; and if J. Y. will immerse a stone that has never been used with oil, in water just to cover it, and then apply an edge-tool, he will find that it will be set very expeditiously. It has, however, been lately ascertained that soap and water are better than either oil or water, as being less expensive, more efficacious, and more cleanly.

Yours, &c. A.

ONE DIFFICULTY SOLVED.

SIR,—In answer to the second inquiry, of J. Y. why a screw-nail is screwed home much easier with a *long* than with a *short* screw-driver, the handles of both being alike? I apprehend that it may arise from this cause—that the *perpendicularity* of the tool is much more easily ascertained and preserved during the operation in one case than in the other.

Yours, &c. A.

EXPANSION OF STEAM.

SIR,—I beg to make, through the medium of your pages, a few ob-

servations on a Table of the Expansive Force of Steam, by Mr. Arthur Woolfe, which I find quoted, with apparent approbation, in "Stuart's History of the Steam Engine," p. 168.

Theory would seem to assign the ratio of the mechanical action of steam to be equal to the power it exerted in a more dense state, when divided by any number of times it may have been allowed to expand from such state. For example, if a cubic foot of the elastic force of 30lbs. per inch be allowed to expand to double its volume, it would then be capable of exerting a force equal to 15lbs. per inch, and if into a space of three cubic feet, it would be only equal to 10lbs. per inch.

It follows, then, that if we multiply 1800, the number of times that steam is considered to be capable of expanding, and to have an elastic force equal to that of the atmosphere, or 15lbs., the atmospheric pressure per inch, the sum will be the elastic force of water per inch, when heated sufficiently to flash instantaneously into steam, or any degree of expansion. Or if 27,000lbs. the sum produced, be divided by the number of expansions it has undergone, the result will be the force it is then capable of exerting.

We know that arithmetical proportions of the mechanical action of steam are obtained by the addition of degrees of heat decreasing in number, as it increases in intensity; therefore, if we were to condense two cubic feet, of 15lbs. per inch, into the space of one, and if more free heat be given out by it than is indicated by steam of 30lbs., it follows that its elastic force would be increased by such excess to a greater degree than is assigned by the above theory; and, on the contrary, the decrease of power by expansion would exceed the proportion of its increase in bulk. But to what extent these increments of increase or decrease exist, and, consequently, what the absolute mechanical action of heated water, or concentrated steam, really is, above what I have laid down, experiment alone can determine; yet, perhaps, the greatest difficulty is, to conceive how steam (say of 212°,) compressed into one-half its volume, should indicate no more, or probably but little more, than 250°, when we may reasonably suppose the atoms of heat in contact with the thermometer to be double the former in number.

From what has been said, the fallacy of the elastic force of the expansions given by Mr. Woolfe may easily be perceived; as, according to them, the mechanical action in effect becomes greater from expansion, or increased rarity. I would fain believe that this statement has been drawn erroneously by some intermediate hand; if not, we may very reasonably question whether the results are really, as stated, the produce of "experiment."

It is stated, "that he has ascertained by experiment, that steam, of an elasticity greater than that of the atmosphere, is capable of expanding itself as many times as its pressure is above that of the atmosphere in pounds weight, *and still to be equal to the air's pressure.*" Suppose, for example, we take steam of an elasticity equal to 16lbs. per inch, or 1 lb. on the safety valve, we are informed that it will expand on a double bulk, and then be equal to 15lbs. per inch. Now, if this be the fact, what dolts must our engineers be, to use steam of 16lbs. per inch, when, by sacrificing 1 lb. of elastic force, a double quantity of steam is obtained, or a power in effect equivalent to 30lbs. per inch?

As atmospheric pressure has no possible influence or control over the rate of expansion, it being merely a standard by which and from whence this power is usually calculated, we will take steam of 18lbs per inch, and allow that to expand into a double volume. The effect must be precisely the same as the first, and hence the force of this expansion will be 17lb. per inch, or in a mechanical effect, equal to 34lbs. per inch. Granting this to be correct for a moment, while the principal is applied to a triple expansion, which again is said to give but 2lbs. less in mechanical force, or 16lbs. per inch, from whence an aggregate of power is consequently obtained equal in effect to

48lbs. per inch, by a sacrifice of only 2lbs. of elasticity. This, however, is evidently at variance with the two first examples, and that it cannot be the fact, requires no very deep penetration to discover; for if a cubic foot of steam will expand into two, with a loss in elasticity of only 1 lb. per inch, does it not follow that those two will expand into force, and only suffer a diminution to the same amount? Obviously they must, if this principle be correct; for whether we take a cubic foot of 18, 17, or 16lbs. per inch, or of any other elastic force, and allow it to expand into two cubic feet, 1 lb. only per inch, more or less, will be lost of its elasticity; and, therefore, if we take steam which has been allowed to expand once, and by it reduced from 18lbs. to 17lbs. per inch, that one cubic foot will again, on the same principle, expand into two, with only 1 lb. loss, as in the former examples. Of what density steam may be used, it can only be regarded as one of a series of expansions emanating from its original state, water; and it matters not to which of such series the principle is applied.

Thus, then, according to Mr. Woolfe, the law of expansion, and its mechanical force, is a decrease in elasticity, or mechanical action, only 1 lb. per inch to double its increase by expansion, and is represented as follows:—

	lbs. pr. in.	ft.	lbs.	
If the elastic force per inch be	18	1	18	mechanical action in effect.
	17	2	34	
	16	4	64	
	15	8	120	

Such a law is opposed to every known principle both of matter and motion; and such an absurdity appearing in print says as little for our theoretical, as it does for our practical knowledge.

I am, Sir, &c. W. G.

GERMAN POLISH.

Sir,—You have given, in your pages, receipts for French Polish and Roman Polish, permit me to add one for German Polish, which I have heard spoken of very highly.

I am, Sir, &c. H.

Melt an ounce of black rosin, and a quarter of a pound of yellow wax, in an earthen pipkin, and pour in, by degrees, two ounces of spirits of turpentine: when the whole is well incorporated, put it in an earthen jar, and keep it close covered for use. When you use it, spread a little of it on the furniture with a woollen cloth, and rub it well in. In a few days the polish will be as hard and as bright as varnish.

FALSE WEIGHTS.

The most common mode of cheating, by means of false weights, is to have the balance so constructed, that when both scales are empty they shall hang even, but, at the same time, have one arm of the balance longer than the other; then, although the weights used may be just, yet, being put into the scale suspended from the short arm, much less than an equal weight will bring the balance even. The best mode of detecting the deceit is to weigh the articles alternately in both scales, when the difference in the results will be immediately manifest.

THEORY OF SPRINGS.

[Remarks on the Theory of Springs, and boring for Water, by J. Mansfield, Professor of Philosophy, Military Academy, West Point.]

None of the theories of spring, or emanations of water from the surface of the earth, has as yet been supported by an *experimentum crucis*, and on that account, our philosophy of them must be considered as hypothetical. I consider the common depth of wells in any country, or region of the earth, as the point of saturation, or where the communicated particles of the earth, whether siliceous, or argillaceous, are completely saturated with water; and where there exists no causes to diminish the *quantum* of fluid in ordinary seasons. Near the surface of the earth, evaporation, and the tendency of the

fluid, by its weight, to descend, necessarily render the parts adjacent to the surface, comparatively dry and unsaturated; insomuch, that no water generally can be obtained by excavation, before you come to the point of complete saturation of the earth by the water; whenever we have arrived at this point, or below it, the water oozes from the earth, from hydrostatic pressure, as from the sides of a vessel in which it is confined, and constitutes what are commonly called wells.

If ever water is found to emanate from the surface of the earth, or above this general level of the point of saturation, as in the case of springs, it must on hydrostatic principles, be owing to some peculiar, or local causes, which protrude the waters above their natural heights in the earth. The causes may either be superior, or more elevated fountains, or water of saturation, with which the springs are connected, or some elastic gasses confined in the earth, which by their repellant force, may protrude the waters to the surface. Adjacent high lands naturally indicate the first cause, and I may venture to say, that there can be no ebullition of water from an extended level surface, except from the latter cause.

It follows from the foregoing, that boring for water, in order that it may flow above the surface of the earth, can only be successful in those places, where, if it were not for the pressure of the superincumbent earth, there would otherwise be springs or fountains; but as there are few places, where the circumstances necessary for the production of springs do exist, there are still fewer, where they exist, and cannot find an outlet; and here are the only places, where boring could advantageously be employed, at least in my opinion.

INQUIRIES.

SHARPING KNIVES.

SIR,—Some of your numerous readers would oblige me (and, I am satisfied, very many others at the same time) with a few *plain* and *simple* directions for giving an Edge to a common Pen-knife. The work, *in nine cases out of ten, is done over and over again;* and although I am told that nothing but habit and constant practice will effect this, I do not entertain a doubt but that many of your readers, *if so disposed*, have the talent to demonstrate how the thing *is done*, and *may be done* by others, upon system, of which they might, at the same time, explain the *rationale*. I am, Sir, &c.

SCRIBA.

TELESCOPES.

SIR,—I beg permission, through the medium of your Magazine, to ask a few questions concerning Telescopes, which I hope that some of your Correspondents will be so kind as to answer.

I wish particularly to know what is the best method for Casting and Polishing Specula for Reflecting Telescopes. I have long had an idea of attempting to make myself one, as I cannot afford to give twenty guineas, which I find is the price of such as I should like to have. I have seen Edward's directions, but I apprehend that improvements must have been made since his time, and that there is a more simple method, and one that comes more within the reach of such men as myself. The particulars of which I am in want are—1st. The method of making the flask and moulding the patterns. 2d. The manner of mixing the metals and the proportions of each. 3d. The process of casting. 4th. What tools are *absolutely necessary* for grinding and polishing the specula. And, 5th. The cost of the materials, separately stated. I should also like to see it explained why a parabolic curve is necessary for the large speculum, and why a spherical curve would not do as well: diagrams, in these instances, would be desirable.

JOHN BARTON.

P. S. I should very much like to see some observations on the comparative goodness of Refracting and Reflecting Telescopes, and what is the most desirable size of such for *general* purposes.